IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

SAINT-GOBAIN GLASS FRANCE, Plaintiff, v. AUTOMOTIVE COMPONENTS HOLDINGS, LLC, Defendant.	))))))))))	C. A. No. ____________

COMPLAINT FOR PATENT INFRINGEMENT

Parties

1. Plaintiff Saint-Gobain Glass France ("Saint-Gobain") is a French corporation with its principal place of business at Les Miroirs, 18 Avenue d'Alsace, F-92400 Courbevoie, France.

2. Upon information and belief, defendant Automotive Components Holdings, LLC ("ACH") is a Delaware corporation with its corporate headquarters in Dearborn, Michigan.

Jurisdiction and Venue

3. This is an action for patent infringement pursuant to 35 U.S.C. § 271. This Court has subject matter jurisdiction pursuant to 28 U.S.C. § 1338(a).

4. Venue in this district is proper under 28 U.S.C. § 1391.

The Patents in Suit

5. Saint-Gobain owns United States patent no. 5,368,917 ("the '917 patent") entitled ACOUSTIC PROTECTIVE GLAZING FOR A VEHICLE issued on November 29, 1994. Pursuant to Local Rule 3.2, the '917 patent is appended hereto as Exhibit A.

6. Saint-Gobain also owns United States patent no. 6,821,629 ("the '629 patent") entitled SOUNDPROOFING LAMINATED WINDOW FOR VEHICLES issued on November 23, 2004. Pursuant to Local Rule 3.2, the '629 patent is appended hereto as Exhibit B.

Allegations of Infringement

7. On information and belief, defendant ACH makes, offers for sale, and sells certain glazings for use in automotive vehicles which infringe the '917 patent.

8. On information and belief, defendant ACH makes, offers for sale, and sells certain glazings for use in automotive vehicles which infringe the '629 patent.

9. Saint-Gobain has given ACH written notice of its infringement of the '917 and '629 patents.

10. On information and belief, the infringement by ACH has been willful.

11. Saint-Gobain has been damaged by such infringement and will continue to be damaged by such infringement unless enjoined by the Court.

Request for Relief

Plaintiff Saint-Gobain respectfully requests:

a. a permanent injunction against continued infringement (35 U.S.C.§ 283),

b. its damages for past infringement (35 U.S.C.§ 284),

c. increased and treble damages for willful infringement (35 U.S.C.§ 284),

d. its attorney fees (35 U.S.C.§ 285),

e. its costs (Rule 54(d), Fed. R. Civ. P.), and

f. any other relief appropriate under the circumstances.

POTTER ANDERSON & CORROON LLP

OF COUNSEL:

By: ______________________

Richard L. Horwitz (#2246)
David E. Moore (#3983)
Hercules Plaza, 6th Floor
1313 N. Market Street
P.O. Box 951
Wilmington, DE 19899-0951
Tel: (302) 984-6000
Rhorwitz@potteranderson.com
dmoore@potteranderson.com

Attorneys for Plaintiff
Saint-Gobain Glass France

Arthur I. Neustadt
Jean-Paul Lavalleye
Aarti Shah
OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.
1940 Duke Street
Alexandria, Virginia 22314
(703) 413-3000

Dated: July 21, 2006

742304

EXHIBIT A

US005368917A

United States Patent [19]

Rehfeld et al.

[11] **Patent Number: 5,368,917**

[45] **Date of Patent: Nov. 29, 1994**

[54] **ACOUSTIC PROTECTIVE GLAZING FOR A VEHICLE**

[75] Inventors: **Marc Rehfeld**, Ezanville; **Michel Canaud**, Paris, both of France

[73] Assignee: **Saint Gobain Vitrage International**, Paris, France

[21] Appl. No.: **145,662**

[22] Filed: **Nov. 4, 1993**

Related U.S. Application Data

[63] Continuation of Ser. No. 491,595, Mar. 12, 1990, abandoned.

[30] **Foreign Application Priority Data**

Mar. 10, 1989 [FR] France 8903137

[51] **Int. Cl.**[5] **B32B 7/02**; B60J 1/02

[52] **U.S. Cl.** **428/215**; 428/34; 428/415; 428/425.6; 428/430; 52/788; 181/286; 181/289; 296/96.14

[58] **Field of Search** 428/415, 417, 418, 34, 428/212, 213, 215, 332, 425.6, 430; 156/107, 109; 52/788, 790, 789; 296/96.14; 181/286, 289, 290

[56] **References Cited**

U.S. PATENT DOCUMENTS

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FOREIGN PATENT DOCUMENTS

2480347	10/1981	France .
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Primary Examiner—Donald J. Loney
Attorney, Agent, or Firm—Oblon, Spivak, McClelland, Maier & Neustadt

[57] **ABSTRACT**

An acoustic glazing intended for land transportation vehicles and including first and second glass sheets separated by an interlayer region, wherein the acoustic transmission loss differs at most by 5 dB from a figure increasing of 9 dB per octave from 800 to 2000 Hz and of 3 dB per octave above that. As examples, double glazings or laminated glazings are presented featuring an interlayer with a pronounced damping. The acoustic glazing will then operate to effectively eliminate aerodynamic noises in moving vehicles.

6 Claims, 3 Drawing Sheets

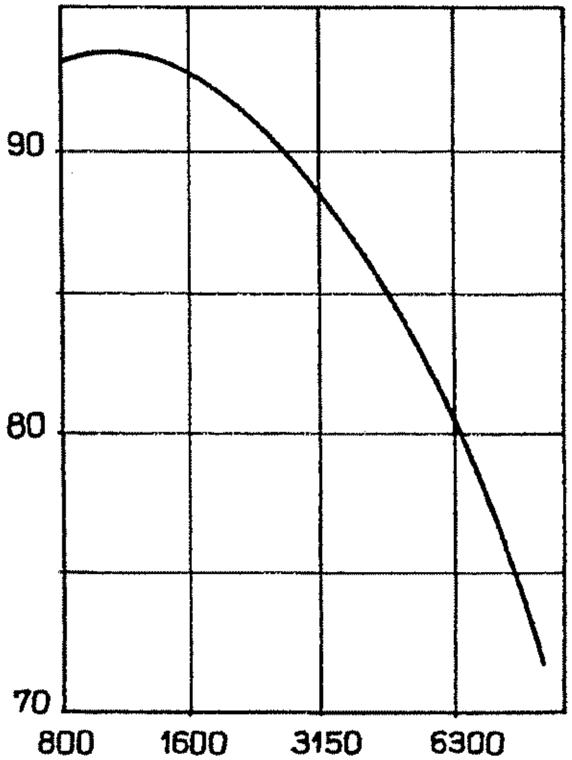

FIG_1

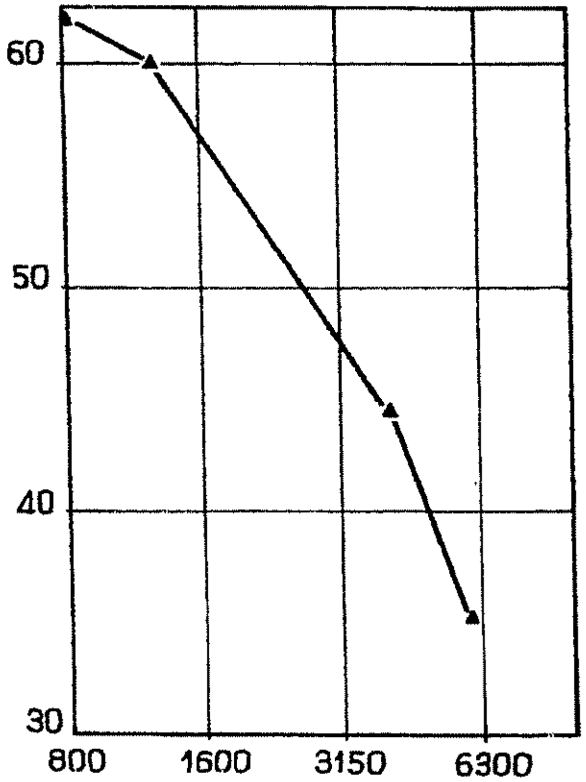

FIG_2

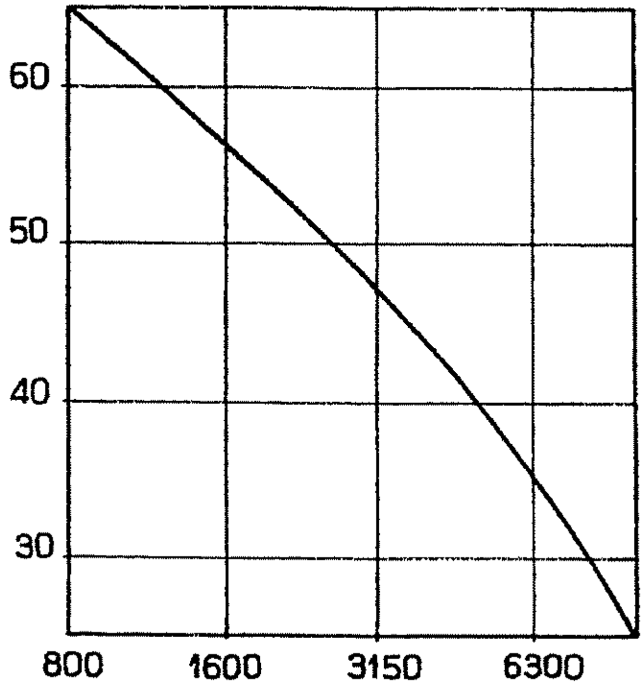

FIG_3

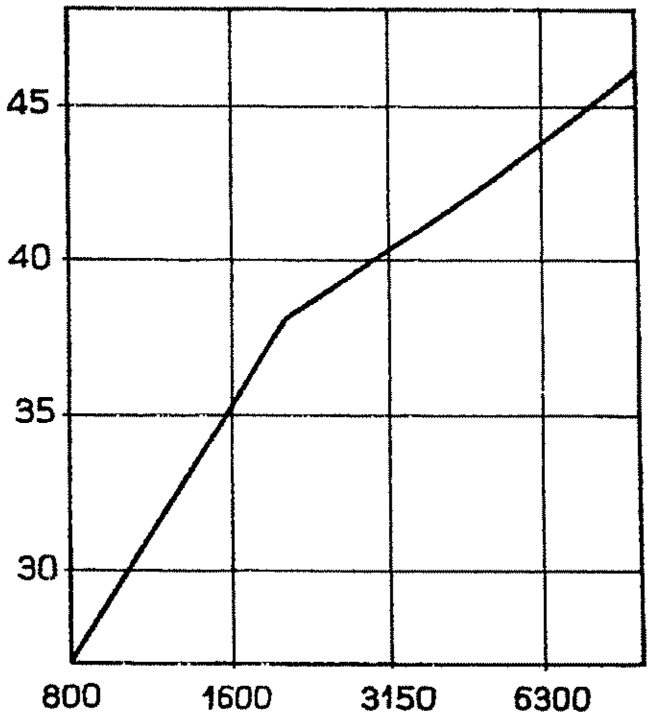

FIG_4

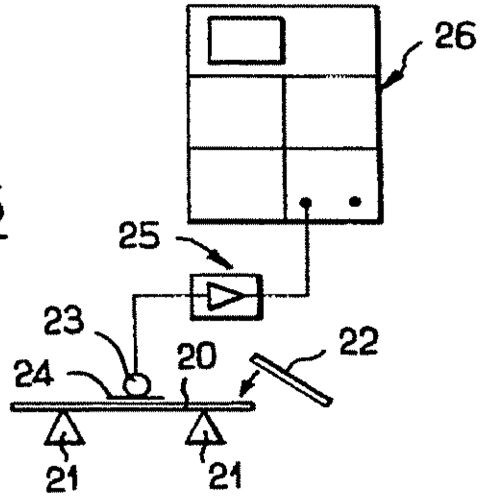

FIG_5

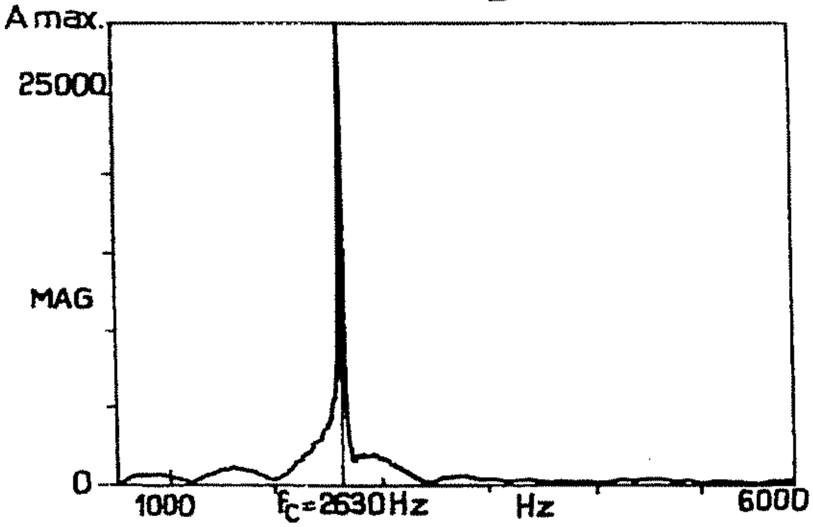

FIG_6

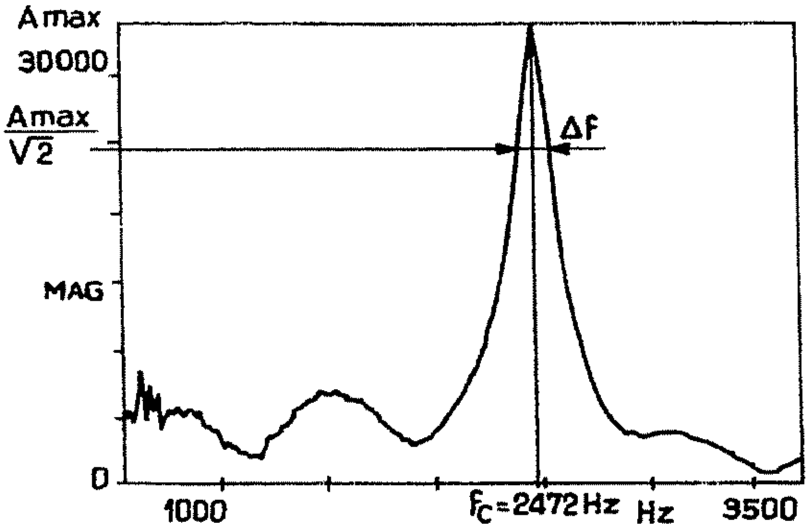

FIG_7

ACOUSTIC PROTECTIVE GLAZING FOR A VEHICLE

This application is a continuation of application Ser. No. 07/491,595, filed on Mar. 12, 1990, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a glazing for a vehicle—and more particularly for a motor vehicle—having improved acoustic insulation performances, and especially in relation to noises of aerodynamic origin.

2. Discussion of the Background

Of all the qualities contributing to comfort in modern transportation vehicles such as trains and automobiles, silence has become decisive. Actually, other sources of annoyance such as of mechanical, heat, or visibility origin, etc. have been gradually overcome. But the improvement of acoustical comfort presents new difficulties as the noises themselves, such as engine noises, and driving or suspension noises, have already been treated at their origin or during their propagation, either by air (absorbing coatings in particular) or by solids (elastomer connecting parts, for example). The aerodynamic noises created by the friction of air moving over the vehicle have been able, at least in part, to be treated at their source, i.e., to save energy, shapes have been changed, penetration in the air has been improved and turbulences which are themselves sources of aerodynamic noise have been reduced.

However, both in the design of the cars of rapid modern trains and in that of automobiles, what could be done to treat the sources of aerodynamic noises has been done and reducing what noises remain, whether the noises are those of a perfect laminar flow or the reduction of the turbulences, requires disproportionate measures whose cost would be incompatible with the profitability of the design studied.

Of the walls of the vehicle that separate the source of outside aerodynamic noise from the interior space where the passenger is located, the glazings are the most difficult to treat. Fibrous or pasty absorbent materials reserved for opaque walls cannot be used and for practical or weight reasons, thicknesses cannot be thoughtlessly increased.

SUMMARY OF THE INVENTION

Accordingly, one object of the present invention is to provide a new and improved glazing that achieves good insulation from noises of aerodynamic origin.

Another object is to provide a novel glazing which achieves good insulation, as above noted, but which does not have either its weight or thickness significantly increased.

These and other objects are achieved according to the present invention by providing a novel glazing including two glass sheets having an interlayer air space or plastic film provided therebetween. The glazing of the present invention, for frequencies greater than 800 hertz, has acoustic transmission losses which do not differ for any frequency, by more than 5 decibels from a reference figure decreasing of 9 dB per octave up to 2000 Hz and of 3 dB per octave at higher frequencies. Moreover, the standard deviation σ in the differences of the acoustic transmission loss in relation to the preceding reference figure remains advantageously less than 4 dB.

In a preferred embodiment, the glazing includes two monolithic glass sheets separated by an air space and whose thicknesses differ from one another by more than 20%. This is the case for glass sheets with respective 2.6 mm and 3.2 mm thicknesses for example or, as another example, for glass sheets with 3.2 mm and 3.9 mm thicknesses.

In a variant, the difference of the thicknesses reaches approximately 40% by using glass sheets with respective thicknesses of about 2 mm and 3 mm, for example.

The preceding insulating glazings will preferably have an interlayer air space of about 3 mm, for example.

In another embodiment a glazing according to the present invention includes a laminated glazing whose interlayer has a flectural bending at its critical frequency that is greater than 0.15. The thicknesses of the two glasses can be identical. According to this variant, this common thickness will be 2.2 mm.

A way of achieving the desired damping includes using as the interlayer a compound comprising on the one hand a thermoplastic resin resulting from the copolymerization of 80% to 98.5% by weight of vinyl chloride and 1% to 10% of glucydyl methacrylate as well as 0.5% to 10% ethylene and, on the other hand, of 10% to 40% by weight of a plasticizer.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed descriptions when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a graph illustrating the medium and high frequency portions of the spectrum of standard road noise;

FIG. 2 is a graph illustrating the spectrum of noise measured inside an automobile at a medium speed;

FIG. 3 is a graph illustrating the noise spectrum that is desired to be reached inside a car at high speed;

FIG. 4 is a graph illustrating the acoustic transmission loss according to the present invention that makes it possible to obtain the desired spectrum; and

FIG. 5 details a testing system that makes it possible to determine the damping at the critical frequency of the resins that make it possible to produce laminated glazings according to the present invention.

FIGS. 6 and 7 present graphical results obtained by utilizing the testing system shown in FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Noises which are perceived on the inside of land vehicles moving at a high speed have multiple origins but each one, depending on its origin, affects a determined zone of the spectrum of acoustic frequencies. Generally, in an automobile, for example, noises of mechanical, engine or transmission origin produce sounds of low frequencies and even, infrasounds; the noises of aerodynamic origin, due to frictions of the vehicle in the air, produce sounds of higher frequencies.

When it is desired to study these noises at their source, in the immediate vicinity and outside the wall of a moving vehicle, extreme experimental difficulties due to the frictions of the microphones in the air are faced and therefore, it is necessary to use indirect testing methods such as, for example, the so-called "double weighing" method. This method consists in making two

successive measurements of the noise on the inside of the vehicle, the first with the vehicle stopped, and the source of noise on the outside being a predetermined perfectly known noise signal. This first measurement makes it possible to gain access to the characteristics of the transmission loss of the entire body. A second measurement is made at a selected speed and under real conditions. Utilizing a reverse calculation, it is possible to determine what precisely the spectrum is of the outside noise, whose effect is measured on the inside.

Applying this method to a comfortable car, i.e., one in which the noises other than those of aerodynamic origin have been reduced as much as possible, shows that at a speed on the order of 130 km/hr, this outside aerodynamic noise is not much different in the range of its high frequency components, from a standard road noise signal as it is ordinarily proposed. Thus, the standard road noise of the French standard NF-S 31051 is, in particular, very close to this outside aerodynamic noise. Such a noise expressed in dB(A) is represented in FIG. 1 (the very high frequencies are extrapolated there).

Since noises of aerodynamic origin are due essentially to the flow of air over the walls of the vehicle, it can furthermore be expected that the spectrum of the aerodynamic noises of a railroad car are not very different from that of a road vehicle. Tests have shown that this is indeed the case. It follows that the following developments relate to glazings intended both for railroad cars and road vehicles.

The idea of acoustic comfort is a matter of each individual's appreciation. Studies made on acoustic comfort in vehicles traveling at high speeds show that the vehicles are considered silent when two conditions are met, first, average sound level is low, and second, the curve representing the noise spectrum is even, without any frequency emerging from the group. Thus, BRYAN, for example ("A Tentative Criterion For Acceptable Noise Levels In Passenger Vehicles"—JOURNAL OF SOUND AND VIBRATION 1977 - 48 (4) p. 525) presents a measured noise spectrum in a vehicle traveling at 100 km/hr and considered by users as silent. FIG. 2 reproduces the spectrum in question expressed in dB(A).

To achieve conditions of acoustic comfort at high speed, the present invention therefore settled on an objective that takes into consideration the preceding observations. Actually, the present invention operates on the finding that if a noise spectrum of the same nature as the one considered as giving an impression of silence in a medium speed vehicle were successfully obtained on the inside of a vehicle traveling at high speed, acoustic comfort would be assured. FIG. 3 presents the objective to be reached expressed in dB(A). This is the noise spectrum that is desired to be obtained on the inside of a vehicle traveling at a high speed, i.e., for which the outside noise would have a spectrum comparable to that of FIG. 1.

The present invention operates on the finding that the glazing of a vehicle meeting these conditions would have to have an acoustic transmission loss whose representative curve deviates as little as possible from the curve reproduced in FIG. 4. It is characterized by a slope of 9 decibels per octave from 800 to 2000 hertz and of 3 decibels per octave from 2,000 to 10,000 hertz. The level of the curve (36 dB at 1600 hertz in FIG. 4) is much less important for the subjective comfort of the passengers than its shape, i.e., it is its two successive slopes and especially its evenness which guarantees the absence of the emergence of isolated frequencies. A curve that is overall offset parallel to that shown in FIG. 4 downward could be less satisfactory but would be in accordance with the present invention and, nevertheless, would give a good impression of comfort. Likewise, a curve offset parallel to that shown in FIG. 4 toward the upper isolations would improve comfort without going outside the scope of the present invention.

Of the glazings able to meet the preceding criterion, there are single sheet window glasses, insulating glazings or laminated glazings.

TABLE I

Frequency (Hz)	Acoustic transmission loss for different types of glazing (dB)							
	0	1	2	3	4	5	6	7
800	27	31	33	32	32	32	27	27
1000	30	35	36	35	36	36	30	31
1250	33	36	37	36	36	36	31	33
1600	36	35	38	36	37	37	34	35.5
2000	39	33	39	36	38	37.5	38	38.5
2500	40	32	39	35	39	38	41	40.5
3150	41	33	39	35	39	37.5	40	39
4000	42	35	38	35	40	38.5	39	37.5
5000	43	38	36	38	39	39	42	40
6300	44	40	38	41	41	41	43	42
8000	45	45	41	44	43	44	43	44.5
10000	46	47	45	49	47	48	46	47.5

Table I exhibits the acoustic transmission loss factors for these different types of glazings. These are in order:

No. 0: the transmission loss of the invention, at 9 dB then 3 dB per octave,

No. 1: glass plate (optionally tempered) 5 mm thick

No. 2: laminated glass 2.2-1.5-2.6 with polyurethane resin

No. 3: laminated glass 2.2-0.76-2.2 with PVB at 25° C.

No. 4: laminated glass 2.2-0.76-2.2 with PVB at 35° C.

No. 5: laminated glass 2.2-1.1-2.2 with special PVC resin

No. 6: insulating glazing 2.0 (3) 3.2 and

No. 7: insulating glazing 2.6 (3) 3.2

(The preceding figures correspond to the thicknesses in millimeters, these thicknesses are given by way of example, they could be considerably modified without going outside the scope of the present invention. This remark applies to glazings 4, 5, 6 and 7).

The measurements of these acoustic attenuation factors have been performed according to the standard ISO-140 in an installation in accordance with that standard on samples with dimensions 80×50 cm.

The sample in No. 1 is of soda lime silica single sheet window glass 5 mm thick which has undergone a standard heat tempering.

Samples 3 and 4 are laminated glazings with a polyvinyl butyral (PVB) base, the thickness of the film being 0.76 mm. To cause the acoustical performances to vary, in particular "the damping at bending at the critical frequency" which will be defined below, the temperature of the sample was modified at the time of measurement.

Likewise, samples 2 and 5 are laminated glasses whose interlayer is different in nature to obtain different acoustical properties. The interlayer of sample No. 2 is a thermoplastic polyurethane with a thickness of 1.5 mm of the MORTHANE PE 192 type provided by the MORTON THIOKOL Company. As for sample No. 5, its interlayer is a film with a polyvinyl chloride (PVC)

base that is modified as described in U.S. Pat. No. 4,382,996. It is a compound comprising, on the one hand, a thermoplastic resin resulting from the copolymerization of 80% to 98.5% by weight of vinyl chloride, of 1% to 10% of glucydyl methacrylate, and of 0.5% to 10% of ethylene and further, on the other hand, of 10% to 40% by weight of a plasticizer. Its thickness is 1.15 mm.

Samples 6 and 7 are standard insulating glazings, only their air space is reduced to 3 mm for reasons of room and their thicknesses selected for acoustical reasons.

The resins used as interlayers are selected for their different dampings. Now, with reference to FIG. 5, the method will be described that makes it possible to make the selection of a resin that can be used within the context of the present invention.

The energy acquired by an object subjected to a shock produces a vibration phenomenon and then immediately after the shock, the object then becomes free and vibrates according to its own modes. A vibration frequency is associated with each mode. The amplitude of the vibration depends on the initial excitation, i.e., on the spectral component of the shock (amplitude of the shock at the studied frequency) and on the impact zone of the shock, the value of normal deformation being more or less depending on whether the shock occurs at a vibration node or antinode.

So that a proper mode is excited, it is necessary that:

(1) the deformation caused at the point of impact not be located on a vibration node of the mode,

(2) the shock energy spectrum have a component at the resonant frequency of the mode.

This latter condition is also met and, for a bar that is free at its ends, for example, it is enough to tap at one of the ends to excite all modes.

Actually, only the first ten modes, at most, can be measured. The vibratory energy acquired by a shock is dissipated over time and faster the more damped the material.

For a given material, the modes are dissipated faster the higher the associated resonant frequency, so that after a certain time, and over a certain period, only the first mode remains.

The principle of the measurement consists, therefore, in performing the analysis of the vibration frequencies of a bar subjected to a shock and in locating the position of the resonant frequencies (frequencies for which the vibration amplitude is clearly larger than in the rest of the spectrum).

To perform the measurement, as shown in FIG. 5, bars 20 are successively used that are 9 cm long and 3 cm wide, first of a glass 4 mm thick, then of a 4×4 laminated glass, in which glass sheets 4 millimeters thick are assembled in a layer X millimeters thick of the resin to be tested.

Bar 20 rests on two foam supports 21, placed approximately at the vibration nodes of the first mode (fundamental mode) of dynamic bending of the bar. The latter is excited by a shock exerted by striking one of its free ends with a small object 22, such as a ruler.

The transient response of the bar to this excitation is picked up by a microphone 23, which is placed on a support 24, very close to the surface of bar 20, in its middle (pressure antinode). The time signal picked up by microphone 23 is amplified by amplifier 25, and then frequency analyzed by a Fourier analyzer 26.

Generally, about ten tests are performed for each same bar 20, to reduce the influence of outside noises.

As can be seen in FIGS. 6 and 7, the curves obtained, which represent amplitude A of the vibrations as a function of their frequency, respectively for a monolithic glass bar and for a laminated glass bar comprising a resin to be tested within the context of this invention, make it possible to detect with precision the resonant frequency of the fundamental mode of the bending vibration (critical frequency). In the examples shown, the critical frequency of the laminated glass bar is 2472 Hz, as shown in FIG. 7.

The test which has just been described and which is very simple to use makes it possible to determine the flectural damping ν of bar 20, which is defined as the $\Delta f/f_c$ where Δf represents the difference of the frequencies corresponding to an amplitude equal to that of the critical frequency f_c, divided by $\sqrt{2}$.

The results of the acoustic transmission loss measurements appearing in Table I make it possible to calculate for each frequency the positive or negative difference between the reference figure (column 0) and the loss of a given product (No. 1 to 7).

For each glazing, the difference is then calculated of the extreme values of these differences calculated at each frequency.

Thus, for example for glazing No. 1, the largest positive value that appears for 1000 Hz is +5. The smallest negative value, at 2500 Hz as at 3150 Hz is −8, the difference of the extremes will therefore be $5-(-8)=13$ and the corresponding deviation relative to the reference figure is, here, therefore 6.5 dB. Actually, it is possible to offset the reference curve so that the positive and negative deviations have the same absolute value, here 6.5 dB. Thus it is seen that when a "difference of the extremes" which has the value E for a given glazing is mentioned, this means that the acoustic transmission loss of the glazing in question does not differ for any frequency by more than E/2 decibels from the reference factor.

For each glazing, the average of the differences in question has also been calculated, as shown in Table 2 below.

Moreover, in each case the standard deviation, σ, of all these differences has been calculated. This value is very interesting because it accounts for the emergence of certain frequencies in the noise spectrum as is perceived in a moving vehicle. When the spectrum is even, the standard deviation remains small, on the other hand, if this spectrum is very disturbed, σ will increase.

TABLE 2

	Difference of the Extremes E (dB)	Average of the Differences (dB)	Standard Deviation of the Differences σ (dB)	Damping ν %
1	13	−2.2	4.6	—
2	13	−0.6	4.2	12
3	13	−1.2	4.2	16
4	10	−0.1	3.0	19
5	10	−0.1	3.3	20
6	4	−1.0	1.1	—
7	5.5	−0.6	1.7	—

Table 2 shows the results for the seven examples under consideration. The dampings measured on the resins used in laminates 2, 3, 4 or 5 have also been shown.

These results show, on the one hand, the very good behavior of the insulating glazings. They deviate very

little from the target-curve (average of the differences −1.0 and −0.6 dB respectively) but especially, the standard deviation of their differences is remarkably small (respectively 1.1 and 1.7 dB). The two examples cited (glazings 6 and 7) are not limiting, the good behavior of other combinations, such as for example 3.2 mm and 3.9 mm, has also been noted.

The 5 mm monolithic glazing appears mediocre.

With laminated glazings, the determining influence of the damping on the standard deviation of the differences is especially noted, i.e., actually on the dispersion of these differences, therefore on the emergence of annoying frequencies in the resulting noise spectrum. The thermoplastic polyurethane resin, glazing No. 2, with a damping ν of 12% provides high differences of the extremes E and a high standard deviation (respectively 13 dB and 4.2 dB). On the other hand, with the same resin, polyvinyl butyral, by varying only the temperature, which goes from 25° C. (glazing No. 3) to 35° C. (glazing No. 4), a 28% improvement in the σ is found. This improvement is due solely to the variation of the damping at the coincidence frequency which goes from 16% to 19% when the temperature of the PVB rises.

In practice, however, it is necessary to have a product which keeps its properties within a considerable range of temperatures.

The modified PVC of laminate No. 5 shows high damping properties (20%) in a very wide temperature range, it therefore gives a very satisfactory response to the problem of the acoustical protection of a vehicle from aerodynamic noises.

Further, the generalized use of laminated glazings on a vehicle offers obvious additional advantages: on railroad cars, it eliminates the danger of throwing of fragments in case of sudden breaking as would be the case with a tempered glass and, on an automobile, it is a break-in retarder, i.e., someone breaking into a parked vehicle to commit a theft would need a clearly longer time if all the windows were laminated.

Thus, it can be seen that the invention proposes a general solution to the problem of acoustical insulation from aerodynamic noises of a land vehicle at high speed. This solution materializes in two types of adapted glazings, one which belongs to the family of glazings with improved heat insulation, an insulating glazing with an air space, the other-to the family of break-in retarding glazings, a laminated glazing with a plastic interlayer.

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore-to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

What is claimed as new and desired to be secured by letters patent of the United States is:

1. An acoustic protective glazing for a vehicle comprising:

a first glass sheet;

a second glass sheet;

said first and second glass sheets positioned so as to form an interlayer region between said first and second glass sheets, wherein the interlayer region. Comprises a plastic interlayer sheet having a flextural damping greater then 0.15;

wherein at least one of the thickness of at least one of said glass sheets and the composition and dimensions of said interlayer region are chosen such that said protective glazing attenuates frequencies higher than 800 Hz and has an acoustic transmission loss which does not differ for any frequency by more than 5 decibels from an increasing reference figure of 9 dB per octave up to 2000 Hz and of 3 dB per octave at higher frequencies, and wherein one of said first and second glass sheets each has a thickness less than 3 mm and another of said first and second glass sheets has a thickness less than 4 mm.

2. The acoustic protective glazing according to claim 1, wherein the thickness of the first and second glass sheets is identical and equal to about 2.2 mm.

3. The acoustic protective glazing according to claim 1, wherein the plastic interlayer sheet comprises a compound having as a base, a thermoplastic resin resulting from the copolymerization of 80% to 98.5% by weight of vinyl chloride, of 1% to 10% of glucydyl methacrylate and of 0.5% to 10% of ethylene, and further comprises 10% to 40% by weight of a plasticizer.

4. An acoustic protective glazing for a vehicle comprising:

a first glass sheet;

a second glass sheet;

said first and second glass sheet positioned so as to form an interlayer region between said first and second glass sheets;

wherein at least one of the thickness of at least one of said glass sheets and the composition and dimensions of said interlayer region are chosen such that said protective glazing attenuates frequencies higher than 800 Hz and has an acoustic transmission loss which does not differ for any frequency by more than 5 decibels from an increasing reference figure of 9 dB per octave up to 2000 Hz and of 3 dB per octave at higher frequencies, and wherein said first and second glass sheets each have a thickness of 2.2 mm.

5. The acoustic protective glazing according to claim 4, wherein the interlayer region comprises a plastic interlayer sheet having a flextural damping greater than 0.15.

6. An acoustic protective glazing for a vehicle comprising:

a first glass sheet;

a second glass sheet;

said first and second glass sheet positioned so as to form an interlayer region between said first and second glass sheets;

wherein at least one of the thickness of at least one of said glass sheets and the composition and dimensions of said interlayer region are chosen such that said protective glazing attenuates frequencies higher than 800 Hz and has an acoustic transmission loss which does not differ for any frequency by more than 5 decibels from an increasing reference figure of 9 dB per octave up to 2000 Hz and of 3 dB per octave at higher frequencies, wherein at least one of said first and second glass sheets has a thickness less than 3 mm, and wherein the interlayer region comprises a plastic interlayer sheet having a flextural damping greater than 0.15, the plastic interlayer sheet comprising a compound having as a base, a thermoplastic resin resulting from copolymerization of 80% to 98.5% by weight of vinyl chloride, of 1% to 10% of glucydyl methacrylate and of 0.5% to 10% of ethylene, and further comprises 10% to 40% by weight of a plasticizer.

* * * * *

EXHIBIT B

US006821629B2

(12) **United States Patent**
Garnier et al.

(10) **Patent No.: US 6,821,629 B2**
(45) **Date of Patent: Nov. 23, 2004**

(54) **SOUNDPROOFING LAMINATED WINDOW FOR VEHICLES**

(75) Inventors: **Gilles Garnier**, Thourotte (FR); **Marc Rehfeld**, Ezanville (FR); **Franz Kraemling**, Aachen (DE)

(73) Assignee: **Saint-Gobain Glass France**, Courbevoie (FR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/028,215**

(22) Filed: **Dec. 28, 2001**

(65) **Prior Publication Data**

US 2002/0068177 A1 Jun. 6, 2002

Related U.S. Application Data

(63) Continuation of application No. 09/488,674, filed on Jan. 21, 2000, now abandoned, which is a continuation of application No. 08/978,024, filed on Nov. 25, 1997, now Pat. No. 6,074,732.

(30) **Foreign Application Priority Data**

Nov. 26, 1996 (FR) 96 14404
Feb. 14, 1997 (DE) 197 05 586

(51) **Int. Cl.**[7] **B32B 5/00**; B32B 7/02; B44F 1/10

(52) **U.S. Cl.** **428/426**; 428/215; 428/216; 428/29; 428/98; 428/212

(58) **Field of Search** 428/212, 29, 98, 428/215, 216; 156/101, 252, 253, 99

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Primary Examiner—Cynthia H. Kelly
Assistant Examiner—L. Ferguson
(74) *Attorney, Agent, or Firm*—Oblon, Spivak, McClelland, Maier & Neustadt, P.C.

(57) **ABSTRACT**

The invention relates to a soundproofing window in which an intermediate film provides for damping of vibrations transmitted in particular by structure-borne conduction.

15 Claims, 2 Drawing Sheets

Fig. 1

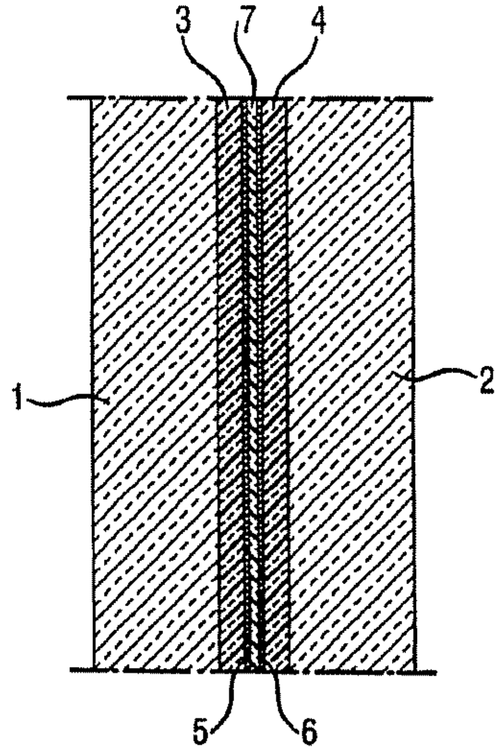
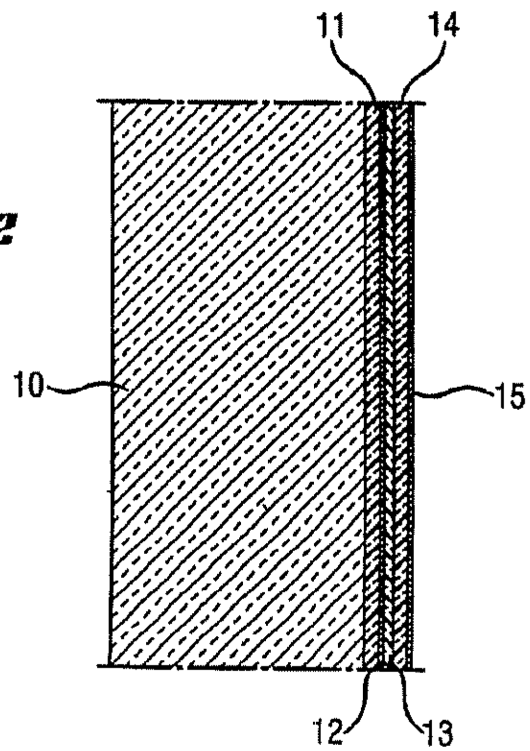
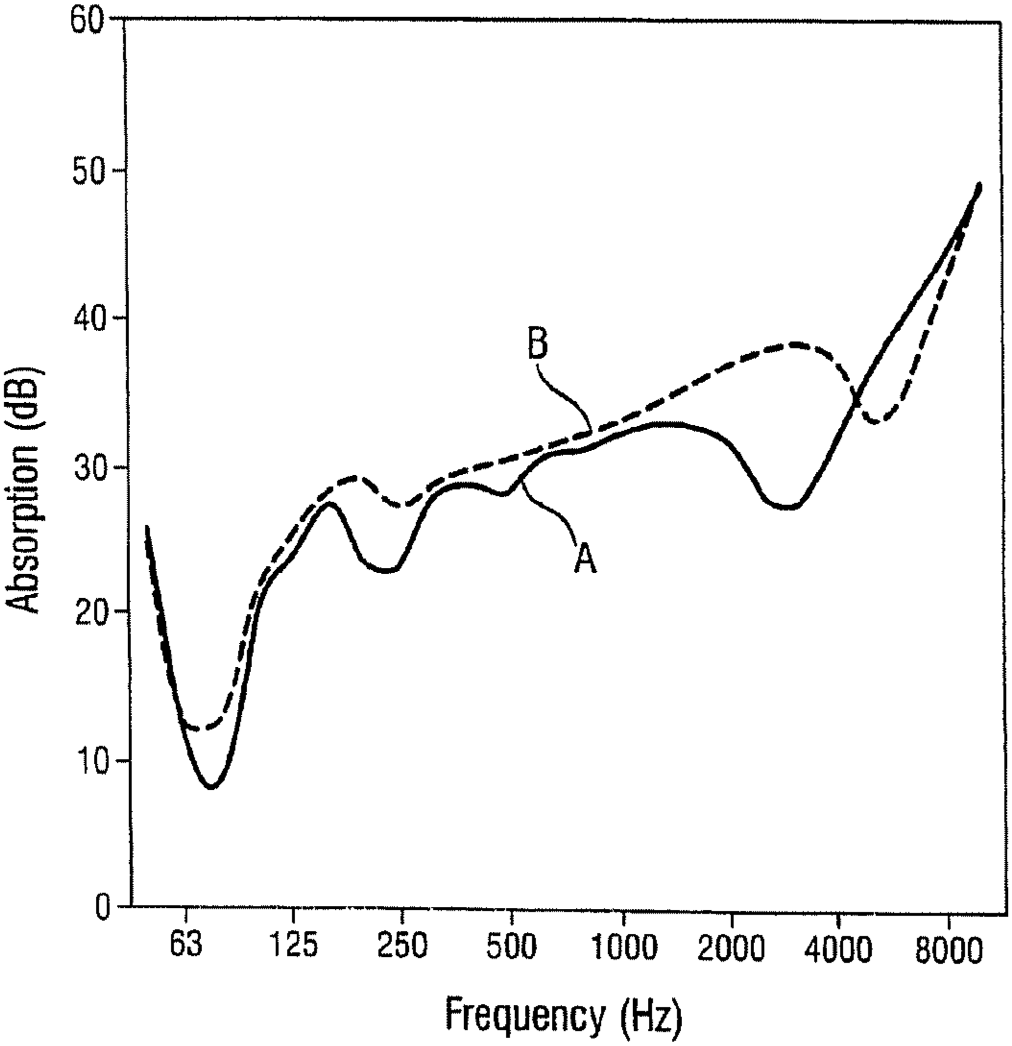


Fig. 2





60
50
40
30
20
10
0
Absorption (dB)
63
125
250
500
1000
2000
4000
8000
Frequency (Hz)
A
B

Fig. 3

SOUNDPROOFING LAMINATED WINDOW FOR VEHICLES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a window for vehicles, particularly automobile vehicles, having improved acoustic insulation properties, especially with respect to noise of structure-borne origin

2. Discussion of the Background

Soundproofing windows are used not only for windows in buildings but also to an increasing extent in automobiles. Although soundproofing windows for buildings can be relatively thick, laminated windows used for automobile construction usually have thicknesses not exceeding about 6 mm. Consequently it is advisable to use, as an intermediate layer between the two sheets of window glass, a viscoelastic polymer that imparts a highly effective anti-noise effect even in relatively thin layers. In addition, the polymer must also satisfy, over the long term (meaning for the entire life of the vehicle) all conditions imposed on polymers used in automobile windows. These conditions include in particular low cloudiness, high transparency and good ultraviolet resistance. In addition, these polymers must ensure high-quality and durable assembly with the adjacent layers and must retain their good noise-damping properties even at high and low temperatures. Finally, the anti-noise layers must not impair the safety-glass properties of the window. Acrylic viscoelastic polymers have proved particularly appropriate as antinoise layers

EP 0 532 478 A2 teaches a soundproofing laminated window that is also suitable as an automobile window and that comprises an intermediate layer of viscoelastic acrylic polymer. In the case of this known laminated window, the intermediate layer separating the two glass sheets is formed by a polymerizable monomeric composition comprising 5 to 50 weight % of an aliphatic polyurethane and 15 to 85 weight % of a photopolymerizable mixture of different acrylic monomers and common polymerization additives. The mixture of monomers is admitted into the space separating the two glass sheets, and polymerization by ultraviolet radiation is initiated. This known soundproofing laminated window is not suitable for series production, however, because its process of production (polymerization of the mixture of monomers introduced between the glass sheets) is relatively expensive.

In the case of the industrial process for production of laminated windows, assembly of the two glass sheets with a prefabricated polymer film is generally performed at elevated temperature and under pressure. A process of this type intended for production of laminated windows having good noise-damping properties is known from EP 0 457 190 A1. In the case of this known process, a prefabricated polymer film having a high noise-damping coefficient and comprising at least two layers, one of which is made from a first specified polyvinyl acetal and plasticizer and the other of a second specified polyvinyl acetal and plasticizer

Viscoelastic acrylic polymers with good noise-damping properties are also known in the form of thin films. These anti-noise films can be used for production of laminated windows by interposing them between two thermoplastic films comprising in particular polyvinylbutyral and bonding them to these films as well as to two external glass sheets by the standard process for production of laminated windows by assembly at elevated temperature and under pressure.

Soundproofing windows of this type have a good noise-damping coefficient, but it has been found that in the course of time the acrylic polymer becomes cloudy and the noise-damping properties deteriorate, with the result that the laminated window thereby becomes useless

On the other hand, among all the qualities contributing to comfort in modern transportation means such as trains and automobiles, silence is becoming the determining factor. In fact, the other sources of discomfort stemming from mechanical, thermal, visibility, and other considerations have been gradually mastered. Improvement of acoustic comfort presents new difficulties, however; noises of aerodynamic origin, in other words noises created by friction between the air and the moving vehicle, have been treated successfully, at least in part, at their source, or in other words, to economize on energy, the shapes have been modified, penetration into the air has been improved, and turbulence effects, which themselves are noise sources, have been reduced. Among the vehicle walls that separate the source of external aerodynamic noise from the inside compartment in which the passenger is situated, windows are obviously the most difficult to treat. Pasty or fibrous absorbing materials intended for opaque walls cannot be used and, for practical or weight reasons, the thicknesses cannot be increased. European Patent EP B1 0 387 148 teaches windows that achieve good insulation from noise of aerodynamic origin without excessive increase in their weight and/or thicknesses. The patent thus teaches a laminated window in which the intermediate layer has a flexural damping coefficient of $\nu=\Delta f/f_c$ larger than 0.15, the measurement being performed by shock excitation of a laminated bar of 9 cm length and 3 cm width made of a laminated glass in which the resin is located between two glass members each 4 mm thick, and by measuring f_c, the resonance frequency of the first mode, and Δf, the peak width at amplitude $A/\sqrt{2}$, where A is the maximum amplitude at frequency f_c, such that its acoustic attenuation index does not differ for any of the frequencies higher than 800 Hz by more than 5 dB from a reference index, which increases by 9 dB per octave up to 2000 Hz and by 3 dB per octave at higher frequencies. In addition, the standard deviation σ of the differences of its acoustic attenuation index relative to the reference index is always smaller than 4 dB. The thicknesses of the two glass members can be identical and equal to 2.2 mm. This patent therefore proposes a general solution to the problem of acoustic insulation of the aerodynamic noises of a vehicle.

However, the noises themselves such as engine noises, bearing noises or suspension noises must be treated at the same time. These noises have already been treated at their origin or to some extent during their propagation, whether airborne (especially absorbing lining) or structure-borne (joints of elastomer, for example). For windows, European Patent EP B1 0 100 701 teaches windows that achieve good soundproofing of highway noises, or in other words good insulation of noises during their airborne propagation.

One of the windows according to this patent comprises at least one laminated window, and the resin of the laminated window is such that a bar of 9 cm length and 3 cm width made of a laminated glass comprising two glass sheets of 4 mm thickness joined together by a 2 mm layer of this resin has a critical frequency that differs by at most 35% from that of a glass bar having the same length, the same width and a thickness of 4 mm. The windows according to this patent have an excellent acoustic attenuation index for highway traffic.

In contrast, the treatment of windows to combat noises of structure-borne origin, meaning noises transmitted through

solids, is more difficult to achieve. In fact, it turns out that the use of joints is still insufficient to prevent transmission of noise by window vibration. In this connection, it has actually been observed that, at certain engine speeds, perceptible buzzing is felt by the passenger, thus causing a source of discomfort. In fact, the engine rotation leads to the development of vibrations which are transmitted, for example, to the car body and then by chain effect to the windows. It is known that the energy acquired by an object subjected to a shock causes a vibration phenomenon, and that, immediately after the shock, once the object has become free again, it vibrates in its natural mode. A vibrational frequency is associated with each mode. The vibrational amplitude depends on the initial excitation, or in other words on the spectral component of the shock (amplitude of the shock at the frequency under study) and of the impact zone of the shock, the magnitude of the modal deformation depending on whether the shock occurred at a neutral point or vibration node.

The following conditions must be met for a natural mode to be excited:

(1) the deformation caused at the point of impact is not situated at a vibration node of the mode,

(2) the energy spectrum of the shock has a component at the resonance frequency of the mode.

This second condition is almost always met, because a very brief shock has a practically uniform energy spectrum.

The first condition is also met and, for a bar free at its ends, for example, it is sufficient to tap one of the ends to excite all modes.

In the application in question, structure-borne excitation is peripheral and the inventors have demonstrated that, at certain engine vibration frequencies, in other words at certain engine speeds, the windows and the passenger compartment of the vehicle each have a vibration mode, the coupling of which amplifies the window buzzing caused by radiation of noises originating in this case from the engine. Of course, the engine speed causing these phenomena is particular to each type of vehicle, and therefore cannot be generalized to a single value.

SUMMARY OF THE INVENTION

The inventors have established that, by using a resin meeting the conditions stated in the introduction, which is different from those proposed in the patents cited hereinabove, to join the sheets of glass in laminated structure, such a structure provides particularly satisfying properties, far superior to those achieved heretofore, for damping audible sounds of structure-borne origin.

OBJECTS OF THE INVENTION

One object of the invention is a vehicle window having acoustic insulation properties and, in particular, properties making it possible to decrease noises radiated by the window under structure-borne excitation.

The invention also has the object of providing a soundproofing laminated window which on the one hand provides great ease of use and good noise-damping properties, and on the other hand retains its good optical properties and absence of cloudiness even over the long term.

Another object of the invention is to provide such a window that achieves good protection from noises of structure-borne origin while conferring on the windows improved acoustic performances with respect to noises or aerodynamic origin and also external noises.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages and characteristics of the invention will become apparent in the following description, provided with reference to the attached drawings, wherein:

FIG. 1 shows a first embodiment of the laminated window according to the invention,

FIG. 2 shows a second embodiment of the laminated window according to the invention; and

FIG. 3 shows the degree of damping as a function of the frequency of a standard laminated window and of the laminated window shown in FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

The window according to the invention is preferably designed to ensure soundproofing of a vehicle and in particular soundproofing against noises of structure-borne origin, and is made of a laminated window comprising at least one glass sheet and one intermediate film having a loss factor tan δ greater than 0.6 and a shear modulus G' smaller than 2×10^7 N/cm^2 in a temperature range between 10 and 60° C., in a frequency range between 50 and 10,000 Hz. These measurements of the dynamic characterization of the material are performed on a viscoanalyzer, for example a Metravib viscoanalyzer, under measurement conditions to be defined hereinafter.

The technique of the invention makes it possible to obtain a soundproofing window made of a laminated window in which the intermediate film brings about damping of the vibrations originating from the engine and transmitted in particular by the car body, to the effect that the radiation of vibrational modes of the window are attenuated so much that coupling with the vibrational modes of the passenger compartment no longer takes place, regardless of engine speed.

According to one embodiment of the invention, the intermediate film imparting damping properties is associated with at least one film of normal acoustic performances. Thus it is permissible to replace part of the thickness of an expensive acoustic film by a "normal" and inexpensive film without deterioration of the acoustic properties but with, for example, an appreciable improvement of the mechanical properties as well as with the entire range of additional properties that can be imparted to such a film: colors, anti-UV, light diffusion, etc.

According to another preferred embodiment of the invention, the intermediate film is a film of thermoplastic acrylic polymer 0.05 to 1.0 mm thick, and this film is joined to a glass sheet with interposition of a polyester film 0.01 to 0.1 mm thick and a layer of thermoplastic cement 0.3 to 0.8 mm thick. In accordance with the invention, a thin film of polyester, especially polyethylene terephthalate, is also interposed between the acrylic polymer film and the layer of thermoplastic cement.

It has been observed that a laminated window of this structure not only can be made without problems by means of standard assembly processes and thus be suitable for series production, but also can permit the exclusion of all the unfavorable influences of the acrylic polymer film by the addition of a thin film of PET between the acrylic polymer film and the layer of thermoplastic cement, which preferably is made of a film of polyvinylbutyral, which is standard for production of laminated windows. In fact, when the acrylic polymer film is in direct contact with the polyvinylbutyral film, particles of the plasticizer of the PVB film apparently diffuse into the acrylic polymer where they cause cloudiness

effects as well as deterioration of the noise-damping properties. Surprisingly, the PET films, even if they have only a very thin thickness of less than 50 μm, represent a perfect barrier to diffusion of the plasticizer from the PVB film. In addition, by virtue of their surface properties, the PET films become joined both to the thermoplastic acrylate film and to the standard PVB films, to the effect that the laminated windows according to the invention satisfy all the requirements, even those concerning long-term strength and safety.

In its simplest embodiment, the laminated window according to the invention is made of two glass sheets between which there are interposed the above-mentioned films in the following sequence of layers: PVB-PET-acrylate-PET-PVB. Obviously the standard PVB films can also be replaced by thermoplastic cement films made of other materials, particularly such films made of appropriate thermoplastic polyurethanes.

According to another embodiment, the laminated window according to the invention consists of only one glass sheet which, in mounted condition, faces the outside, while the surface of the laminated window facing the passenger compartment is formed by a polymer layer having adequate abrasion resistance. Such windows of glass and synthetic material offer certain advantages as regards the weight and safety properties, and are known as such in different forms.

Films made of viscoelastic acrylic polymers having a shear modulus G' between $10^{6.5}$ Pa at 0° C. and $10^{4.5}$ Pa at 60° C. as well as a loss factor tan δ between approximately 0.8 and 1 in a temperature range of 0 to 60° C. have proved particularly appropriate for the invention. They include, for example, the products of the 3M Corporation sold under the name "Scotchdamp Polymers", the product brochures and MSD sheets thereof being incorporated herein by reference. These products comprise acrylic polymers that do not contain plasticizers and have damping properties covering a broad temperature range. The product type ISD 112, the damping properties of which are in the temperature range between 0 and 60° C., has proved particularly appropriate. The preparation of intermediate films meeting the characteristics described herein is within the skill of the ordinary artisan.

According to an advantageous embodiment of the invention, one of the layers of the laminated window, particularly a polyethylene terephthalate film, is provided with a layer that reflects infrared radiation.

The present invention also relates to the intermediate film that imparts damping properties with respect to vibrations, transmitted in particular by structure-borne conduction.

According to one embodiment of the invention, the laminated window contains two glass sheets of identical thickness. This common thickness is not limited, and may be equal to 2.2 mm. Thus the technique of the invention makes it possible to obtain a soundproofing window with relatively small total thickness.

According to a particular embodiment of the invention, the intermediate film imparting noise-damping properties is based on plasticizer and polyvinylacetal resins.

According to an advantageous embodiment of the invention, the shear modulus G' of the intermediate film imparting noise-damping properties is between 10^6 and 2×10^7 N/m^2.

The laminated window according to the invention is preferably used for acoustic attenuation of noises of structure-borne origin.

The windows according to the invention have the advantage that good insulation with respect to noises of structure-borne origin is achieved, as is also good insulation with respect to noises of aerodynamic origin and external noises.

The dynamic characterization of the intermediate film is performed on a viscoanalyzer of the Metravib viscoanalyzer type, under certain measurement conditions as listed hereinbelow:

sinusoidal loading,

double-shear test specimen, made of two rectangles of the following dimensions:

thickness=3.31 mm

width=10.38 mm

height=6.44 mm

dynamic amplitude: ±5 mm around rest position,

frequency range: 5 to 700 Hz

temperature range: −20 to +60° C

By means of the viscoanalyzer, a material specimen can be subjected to deforming loads under precise temperature and frequency conditions, so that the entirety of the Theological variables characterizing the material can be measured and treated.

The raw data of the measurements of force, displacement and phase shift as a function of frequency at each temperature are processed according to techniques known to those of ordinary skill in the art in order to calculate, in particular, the following variables:

elastic component (or shear modulus) G',

tangent of the loss angle (or loss factor) tan δ.

The master curves of G' and tan δ are therefore plotted as a function of frequency at different temperatures by using the frequency/temperature equivalence law.

These master curves are processed to reveal the glass transition zones. The damping at the glass transition point is then calculated.

In fact, it is at the glass transition point that damping is best.

The technique according to the invention provides a laminated window for vehicles comprising an intermediate film having good damping of noises transmitted by solids. This damping can also satisfy the criteria of insulation against aerodynamic noises and external noises. Thus the window according to the invention makes it possible to achieve good general soundproofing.

DETAILED DESCRIPTION OF THE FIGURES AND EXAMPLES

FIG. 1 is a partial cross-sectional view of the structure of a laminated window such as used for windshields and also increasingly for the side windows and rear windows. Of course, it is also possible to use the same structure for windshields and rear windows of automobiles, possibly with silicate-glass sheets of slightly different thicknesses.

The laminated window is made of two silicate glass sheets **1**, **2** each 1.8 to 3 mm in thickness, two polyvinylbutyral layers **3**, **4** each 0.38 mm in thickness, two thin PET films **5**, **6**, and one film **7** of viscoelastic acrylic polymer interposed between the PET films. The PET films **5**, **6** respectively have a thickness of 0.05 mm. The film **7** consists of a film of Scotchdamp polymer of 0.05 mm thickness, of ISD 112 type, made by 3M. The different layers are juxtaposed in the manner that is standard for fabrication of laminated windows, and they are assembled at elevated temperature and under pressure.

The PET film 5 or the PET film 6 can be placed on one face of a system of layers that reflect infrared radiation. In addition to its noise-damping properties, such a window capable of reflecting infrared radiation ensures a greater thermally insulating effect with respect to incident thermal radiation. In addition, the laminated windows according to the invention have greater shattering resistance by virtue of the integration of PET films, and so automobile windows of very great comfort can be made in this way.

The laminated window shown in FIG. 2 comprises only one silicate-glass sheet 10. The silicate-glass sheet 10, with thickness of 4 mm, for example, is turned such that it faces toward the outside of the automobile when in installed condition. A PVB layer 11 of 0.76 mm thickness is joined to the silicate-glass sheet 10. The PVB layer 11 is followed by a PET film 12 of 0.05 mm thickness, a Scotchdamp polymer film 13 of ISD 112 type of 0.05 mm thickness, and a PET film 14 of 0.1 mm thickness, which is provided on its free surface with an abrasion-resistant layer 15. As in the case of the first described embodiment, the PET film 12 or the PET film 14 can also be provided if necessary with a layer that reflects infrared radiation, for example a multiple layer applied by a vacuum process and comprising a functional layer of silver.

The diagram shown in FIG. 3 demonstrates the improvement of noise damping achieved by the invention. In this diagram, the noise damping expressed in dB is plotted as a function of frequency, both for a laminated window of standard structure (curve A) and for a laminated window with the structure described with reference to FIG. 1 (curve B). The measurements are performed on flat laminated windows with dimensions of 80×50 mm at 20° C. The thickness of the silicate-glass sheets in both cases is 2.1 mm. The comparison model exhibiting the damping profile of curve A has the following structure: 2.1 mm of glass, 0.76 mm of PVB, 2.1 mm of glass, while the model according to the invention has the following structure: 2.1 mm of glass, 0.38 mm of PVB, 0.05 mm of PET, 0.05 mm of acrylic polymer, 0.05 mm of PET, 0.38 mm of PVB, 2.1 mm of glass.

The results show that the degree of damping of the window according to the invention is superior to the degree of damping of the comparison window in by far the greater part of the frequency spectrum. Nevertheless, it is especially in the region approximately between 200 and 300 Hz and in the coincidence frequency region at approximately 3000 Hz, where the damping curves of the windows exhibit the greatest valleys in the case of the standard laminated window, that the measured degrees of noise damping are clearly higher, and so, on the whole, a considerable improvement of noise damping is achieved.

French Patent Application 96 14 404 and German Patent Application 197 05 586.3 are incorporated herein by reference.

What is claimed as new and is desired to be secured by Letters Patent of the United States is:

1. A laminated window comprising a glass sheet and an intermediate film, wherein said film has a loss factor tan δ greater than 0.6 and a shear modulus G' smaller than 2×10^7 N/m^2 in a temperature range between 10 and 60° C. and in a frequency range between 50 and 10,000 Hz, wherein said intermediate film is associated with at least one film of normal acoustic performance.

2. A laminated window comprising a glass sheet and an intermediate film, wherein said film has a loss factor tan δ greater than 0.6 and a shear modulus G' smaller than 2×10^7 N/m^2 in a temperature range between 10 and 60° C. and in a frequency range between 50 and 10,000 Hz, further comprising a thermoplastic cement film, a polyester film interposed between the thermoplastic cement film and the intermediate film, and a polyester film juxtaposed on the other face of the intermediate film and provided on its free surface with an abrasion-resistant layer.

3. A laminated window comprising a glass sheet and an intermediate film, wherein said film has a loss factor tan δ greater than 0.6 and a shear modulus G' smaller than 2×10^7 N/m^2 in a temperature range between 10 and 60° C. and in a frequency range between 50 and 10,000 Hz, wherein the intermediate film comprises viscoelastic polymer made of acrylic polymer without plasticizer having a shear modulus G' between $10^{4.5}$ Pa at 60° C. and $10^{6.5}$ Pa at 0° C. as well as a loss factor tan δ between approximately 0.8 and 1 in a temperature range of 0 to 60° C.

4. A film designed to be used as an intermediate layer in a soundproofing laminated window, said film having a loss factor tan δ greater than 0.6 and a shear modulus G' smaller than 2×10^7 N/m^2 in a temperature range between 10 and 60° C. and in a frequency range between 50 and 10,000 Hz.

5. The film of claim 4, wherein said film is associated with at least one film of normal acoustic performance.

6. The film of claim 5, wherein said film is a thermoplastic acrylic polymer film 0.05 to 1.0 mm thick, and wherein said film is joined to at least one glass sheet with interposition of a polyester film 0.01 to 0.1 mm thick and a thermoplastic cement film 0.3 to 0.8 mm thick.

7. The film of claim 6, wherein the thermoplastic film comprises viscoelastic polymer made of acrylic polymer without plasticizer having a shear modulus G' between $10^{4.5}$ Pa at 60° C. and $10^{6.5}$ Pa at 0° C., as well as a loss factor tan δ between approximately 0.8 and 1 in a temperature range of 0 to 60° C.

8. The film of claim 4, wherein said film comprises plasticizers and polyvinylacetal resins.

9. A film useful as an intermediate layer in a soundproofing laminated window, said film having a loss factor tan δ greater than 0.6 and a shear modulus G' smaller than 2×10^7 N/m^2 at a temperature of 20° C. and at a frequency of 50 Hz.

10. The film of claim 9, wherein said film is associated with at least one film of normal acoustic performance.

11. The film of claim 10, wherein said film is a thermoplastic acrylic polymer film 0.05 to 1.0 mm thick, and wherein said film is joined to at least one glass sheet with interposition of a polyester film 0.01 to 0.1 mm thick and a thermoplastic cement film 0.3 to 0.8 mm thick.

12. A laminated window comprising a glass sheet and the film of claim 9.

13. A laminated window comprising a glass sheet and the film of claim 10.

14. A laminated window comprising a glass sheet and the film of claim 11.

15. A laminated window comprising a glass sheet and the film of claim 9, wherein said film comprises plasticizers and polyvinylacetal resins.

* * * * *

JS 44 (Rev 3/99)

CIVIL COVER SHEET

The JS-44 civil cover sheet and the information contained herein neither replace nor supplement the filing and service of pleadings or other papers as required by law, except as provided by local rules of court This form, approved by the Judicial Conference of the United States in September 1974, is required for the use of the Clerk of Court for the purpose of initiating the civil docket sheet (SEE INSTRUCTIONS ON THE REVERSE OF THE FORM)

I. (a) PLAINTIFFS

SAINT-GOBAIN GLASS FRANCE

DEFENDANTS

AUTOMOTIVE COMPONENTS HOLDINGS, LLC

(b) County of Residence of First Listed Plaintiff ____________
(EXCEPT IN U S PLAINTIFF CASES)

County of Residence of First Listed Defendant
(IN U S PLAINTIFF CASES ONLY)
NOTE: IN LAND CONDEMNATION CASES, USE THE LOCATION OF THE LAND INVOLVED

(c) Attorney's (Firm Name, Address, and Telephone Number)

Potter Anderson & Corroon LLP
Hercules Plaza, 6th Floor
1313 N Market Street, P.O Box 951
Wilmington, DE 19899-0951

Attorneys (If Known)

II. BASIS OF JURISDICTION (Place an "X" in One Box Only)

- [ ] 1 U S. Government Plaintiff
- [x] 3 Federal Question (U S Government Not a Party)
- [ ] 2 U S Government Defendant
- [ ] 4 Diversity (Indicate Citizenship of Parties in Item III)

III. CITIZENSHIP OF PRINCIPAL PARTIES (Place an "X" in One Box for Plaintiff and One Box for Defendant)
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Citizen of Another State	[ ] 2	[ ] 2	Incorporated *and* Principal Place of Business In Another State	[ ] 5	[ ] 5
Citizen or Subject of a Foreign Country	[ ] 3	[ ] 3	Foreign Nation	[ ] 6	[ ] 6

IV. NATURE OF SUIT (Place an "X" in One Box Only)

CONTRACT
- [ ] 110 Insurance
- [ ] 120 Marine
- [ ] 130 Miller Act
- [ ] 140 Negotiable Instrument
- [ ] 150 Recovery of Overpayment & Enforcement of Judgment
- [ ] 151 Medicare Act
- [ ] 152 Recovery of Defaulted Student Loans (Excl Veterans)
- [ ] 153 Recovery of Overpayment of Veteran's Benefits
- [ ] 160 Stockholders' Suits
- [ ] 190 Other Contract
- [ ] 195 Contract Product Liability

REAL PROPERTY
- [ ] 210 Land Condemnation
- [ ] 220 Foreclosure
- [ ] 230 Rent Lease & Ejectment
- [ ] 240 Torts to Land
- [ ] 245 Tort Product Liability
- [ ] 290 All Other Real Property

TORTS

PERSONAL INJURY
- [ ] 310 Airplane
- [ ] 315 Airplane Product Liability
- [ ] 320 Assault, Libel & Slander
- [ ] 330 Federal Employers' Liability
- [ ] 340 Marine
- [ ] 345 Marine Product Liability
- [ ] 350 Motor Vehicle
- [ ] 355 Motor Vehicle Product Liability
- [ ] 360 Other Personal Injury

PERSONAL INJURY
- [ ] 362 Personal Injury— Med. Malpractice
- [ ] 365 Personal Injury — Product Liability
- [ ] 368 Asbestos Personal Injury Product Liability

PERSONAL PROPERTY
- [ ] 370 Other Fraud
- [ ] 371 Truth in Lending
- [ ] 380 Other Personal Property Damage
- [ ] 385 Property Damage Product Liability

CIVIL RIGHTS
- [ ] 441 Voting
- [ ] 442 Employment
- [ ] 443 Housing/ Accommodations
- [ ] 444 Welfare
- [ ] 440 Other Civil Rights

PRISONER PETITIONS
- [ ] 510 Motions to Vacate Sentence
- Habeas Corpus:
- [ ] 530 General
- [ ] 535 Death Penalty
- [ ] 540 Mandamus & Other
- [ ] 550 Civil Rights
- [ ] 555 Prison Condition

FORFEITURE/PENALTY
- [ ] 610 Agriculture
- [ ] 620 Other Food & Drug
- [ ] 625 Drug Related Seizure of Property 21 USC
- [ ] 630 Liquor Laws
- [ ] 640 R.R. & Truck
- [ ] 650 Airline Regs.
- [ ] 660 Occupational Safety/Health
- [ ] 690 Other

LABOR
- [ ] 710 Fair Labor Standards Act
- [ ] 720 Labor/Mgmt Relations
- [ ] 730 Labor/Mgmt Reporting & Disclosure Act
- [ ] 740 Railway Labor Act
- [ ] 790 Other Labor Litigation
- [ ] 791 Empl Ret. Inc Security Act

BANKRUPTCY
- [ ] 422 Appeal 28 USC 158
- [ ] 423 Withdrawal 28 USC 157

PROPERTY RIGHTS
- [ ] 820 Copyrights
- [x] 830 Patent
- [ ] 840 Trademark

SOCIAL SECURITY
- [ ] 861 HIA (1395ff)
- [ ] 862 Black Lung (923)
- [ ] 863 DIWC/DIWW (405(g))
- [ ] 864 SSID Title XVI
- [ ] 865 RSI (405(g))

FEDERAL TAX SUITS
- [ ] 870 Taxes (U S Plaintiff or Defendant)
- [ ] 871 IRS—Third Party 26 USC 7609

OTHER STATUTES
- [ ] 400 State Reapportionment
- [ ] 410 Antitrust
- [ ] 430 Banks and Banking
- [ ] 450 Commerce/ICC Rates/etc
- [ ] 460 Deportation
- [ ] 470 Racketeer Influenced and Corrupt Organizations
- [ ] 810 Selective Service
- [ ] 850 Securities/Commodities/ Exchange
- [ ] 875 Customer Challenge 12 USC 3410
- [ ] 891 Agricultural Acts
- [ ] 892 Economic Stabilization Act
- [ ] 893 Environmental Matters
- [ ] 894 Energy Allocation Act
- [ ] 895 Freedom of Information Act
- [ ] 900 Appeal of Fee Determination Under Equal Access to Justice
- [ ] 950 Constitutionality of State Statutes
- [ ] 890 Other Statutory Actions

V. ORIGIN (PLACE AN "X" IN ONE BOX ONLY)

- [x] 1 Original Proceeding
- [ ] 2 Removed from State Court
- [ ] 3 Remanded from Appellate Court
- [ ] 4 Reinstated or Reopened
- [ ] 5 Transferred from another district (specify)
- [ ] 6 Multidistrict Litigation
- [ ] 7 Appeal to District Judge from Magistrate Judgment

VI. CAUSE OF ACTION (Cite the U S. Civil Statute under which you are filing and write brief statement of cause Do not cite jurisdictional statutes unless diversity)

35 U.S.C. § 271, et seq for patent infringement

VII. REQUESTED IN COMPLAINT: [ ] CHECK IF THIS IS A CLASS ACTION UNDER F R C P 23 DEMAND $ ____ CHECK YES only if demanded in complaint: JURY DEMAND: [ ] Yes [x] No

VIII. RELATED CASE(S) IF ANY (See instructions): JUDGE ____________ DOCKET NUMBER ____________

DATE 07/21/2006 SIGNATURE OF ATTORNEY OF RECORD (3983)

FOR OFFICE USE ONLY

RECEIPT # ______ AMOUNT ______ APPLYING IFP ______ JUDGE ______ MAG JUDGE ______

JS 44 Reverse (Rev 12/96)

INSTRUCTIONS FOR ATTORNEYS COMPLETING CIVIL COVER SHEET FORM JS-44

Authority For Civil Cover Sheet

The JS-44 civil cover sheet and the information contained herein neither replaces nor supplements the filings and service of pleading or other papers as required by law, except as provided by local rules of court. This form, approved by the Judicial Conference of the United States in September 1974, is required for the use of the Clerk of Court for the purpose of initiating the civil docket sheet Consequently, a civil cover sheet is submitted to the Clerk of Court for each civil complaint filed The attorney filing a case should complete the form as follows:

I. **(a) Plaintiffs-Defendants.** Enter names (last, first, middle initial) of plaintiff and defendant If the plaintiff or defendant is a government agency, use only the full name or standard abbreviations. If the plaintiff or defendant is an official within a government agency, identify first the agency and then the official, giving both name and title

(b.) County of Residence. For each civil case filed, except U.S plaintiff cases, enter the name of the county where the first listed plaintiff resides at the time of filing In U.S plaintiff cases, enter the name of the county in which the first listed defendant resides at the time of filing. (NOTE: In land condemnation cases, the county of residence of the "defendant" is the location of the tract of land involved)

(c) Attorneys Enter the firm name, address, telephone number, and attorney of record. If there are several attorneys, list them on an attachment, noting in this section "(see attachment)"

II. **Jurisdiction** The basis of jurisdiction is set forth under Rule 8(a), F.R.C.P., which requires that jurisdictions be shown in pleadings Place an "X" in one of the boxes If there is more than one basis of jurisdiction, precedence is given in the order shown below.

United States plaintiff (1) Jurisdiction based on 28 U.S.C 1345 and 1348 Suits by agencies and officers of the United States, are included here

United States defendant (2) When the plaintiff is suing the United States, its officers or agencies, place an "X" in this box

Federal question (3) This refers to suits under 28 U.S.C. 1331, where jurisdiction arises under the Constitution of the United States, an amendment to the Constitution, an act of Congress or a treaty of the United States In cases where the U.S. is a party, the U.S plaintiff or defendant code takes precedence, and box 1 or 2 should be marked

Diversity of citizenship (4) This refers to suits under 28 U.S.C. 1332, where parties are citizens of different states When Box 4 is checked, the citizenship of the different parties must be checked. (See Section III below; federal question actions take precedence over diversity cases)

III. **Residence (citizenship) of Principal Parties.** This section of the JS-44 is to be completed if diversity of citizenship was indicated above. Mark this section for each principal party.

IV. **Nature of Suit.** Place an "X" in the appropriate box. If the nature of suit cannot be determined, be sure the cause of action, in Section IV below, is sufficient to enable the deputy clerk or the statistical clerks in the Administrative Office to determine the nature of suit If the cause fits more than one nature of suit, select the most definitive

V. **Origin** Place an "X" in one of the seven boxes

Original Proceedings (1) Cases which originate in the United States district courts

Removed from State Court (2) Proceedings initiated in state courts may be removed to the district courts under Title 28 U.S.C., Section 1441. When the petition for removal is granted, check this box

Remanded from Appellate Court (3) Check this box for cases remanded to the district court for further action. Use the date of remand as the filing date

Reinstated or Reopened (4) Check this box for cases reinstated or reopened in the district court Use the reopening date as the filing date.

Transferred from Another District (5) For cases transferred under Title 28 U.S.C. Section 1404(a) Do not use this for within district transfers or multidistrict litigation transfers

Multidistrict Litigation (6) Check this box when a multidistrict case is transferred into the district under authority of Title 28 U.S.C. Section 1407. When this box is checked, do not check (5) above.

Appeal to District Judge from Magistrate Judgment (7) Check this box for an appeal from a magistrate judge's decision

VI. **Cause of Action** Report the civil statute directly related to the cause of action and give a brief description of the cause.

VII. **Requested in Complaint** Class Action. Place an "X" in this box if you are filing a class action under Rule 23, F.R.Cv.P.

Demand. In this space enter the dollar amount (in thousands of dollars) being demanded or indicate other demand such as a preliminary injunction.

Jury Demand. Check the appropriate box to indicate whether or not a jury is being demanded.

VIII. **Related Cases** This section of the JS-44 is used to reference related pending cases if any If there are related pending cases, insert the docket numbers and the corresponding judge names for such cases

Date and Attorney Signature Date and sign the civil cover sheet

AO FORM 85 RECEIPT (REV. 9/04)

United States District Court for the District of Delaware

Civil Action No. 06 - 446

ACKNOWLEDGMENT OF RECEIPT FOR AO FORM 85

NOTICE OF AVAILABILITY OF A UNITED STATES MAGISTRATE JUDGE TO EXERCISE JURISDICTION

I HEREBY ACKNOWLEDGE RECEIPT OF 1 COPIES OF AO FORM 85.

7/21/06
(Date forms issued)

Patrick Boyer
(Signature of Party or their Representative)

Patrick Boyer
(Printed name of Party or their Representative)

Note: Completed receipt will be filed in the Civil Action